FLUORIDE EMISSIONS &
BASIC DRY SCRUBBER OPRS.

5. FLUORIDE EMISSIONS[1]

Pollutants emitted from primary aluminum plants include fluorides, particulates, hydrocarbons (organics), sulfur oxides, carbon monoxide, and nitrogen oxides. EPA tests have shown nitrogen oxide levels to be insignificant. Although significant levels of sulfur oxides and carbon monoxide can be emitted, control technology has not been demonstrated and adequate source test data defining emission levels have not been obtained for these two pollutants. On the other hand, fluoride control has been demonstrated and characterized through EPA source tests. These tests have also shown that, if fluorides are well controlled, the resulting incidental control of particulates and organics will be good. For these reasons, the EPA standards of performance for new primary aluminum plants are stated in terms of fluoride. Likewise, discussion of emissions, control techniques, economic impact and emission standards in this document is restricted to fluorides except where other pollutants have a bearing on cost or performance.

5.1 POINTS OF EMISSION[1,2]

The principal points of fluoride emission are the primary and secondary emissions from the potrooms housing the reduction cells and, in the case of the prebake cell, the emissions from the associated anode bake plant. Figure 5-1 shows these emission points from a prebake plant with an anode ring furnace. The anode bake plant, together with its emissions, is not part of the Soderberg plant.

Figure 5-2 shows how the reduction cells are hooded and how the evolved gas stream is ducted to a primary control device exterior to

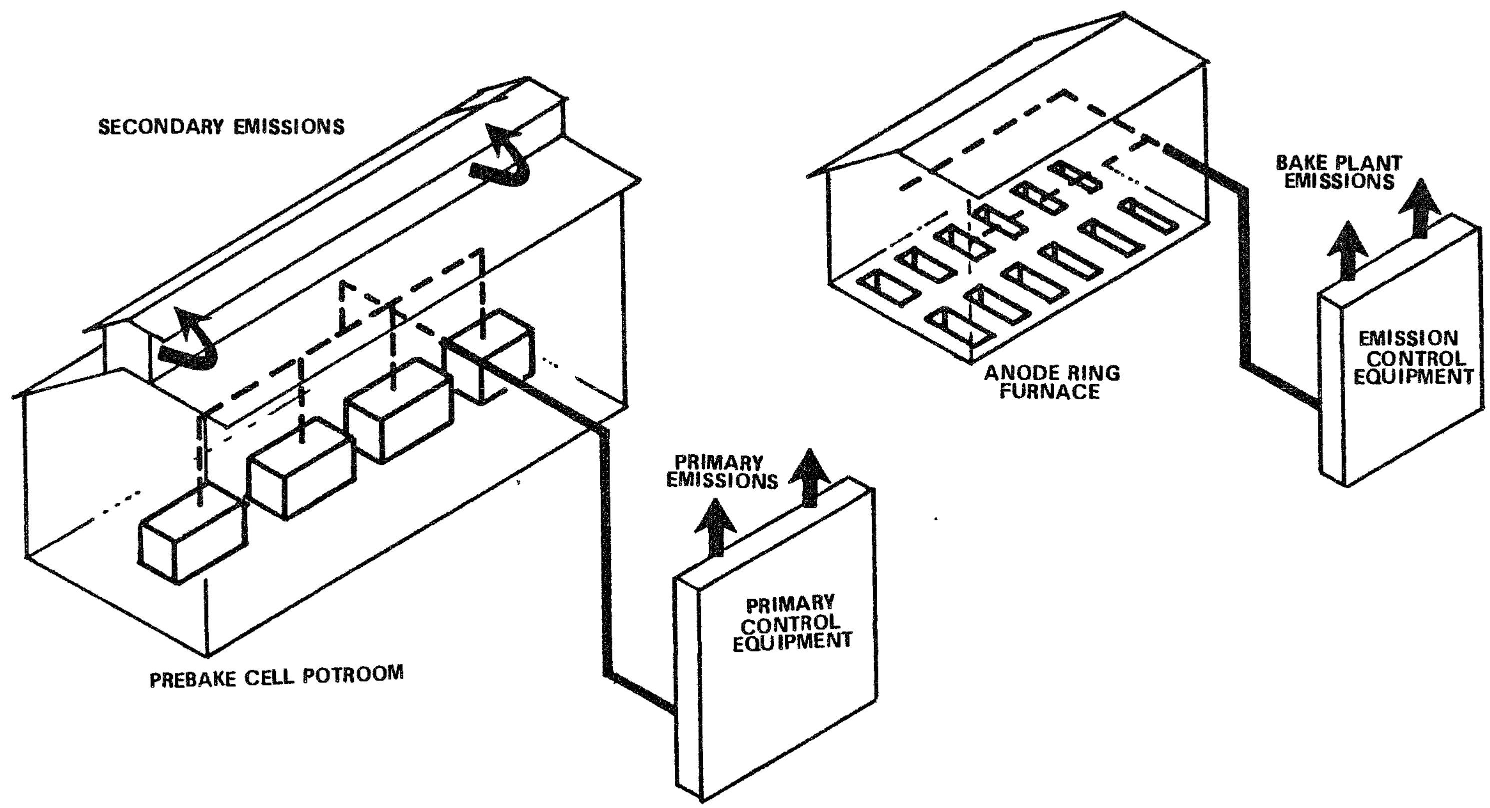

Figure 5-1. Prebake plant with anode ring furnace.

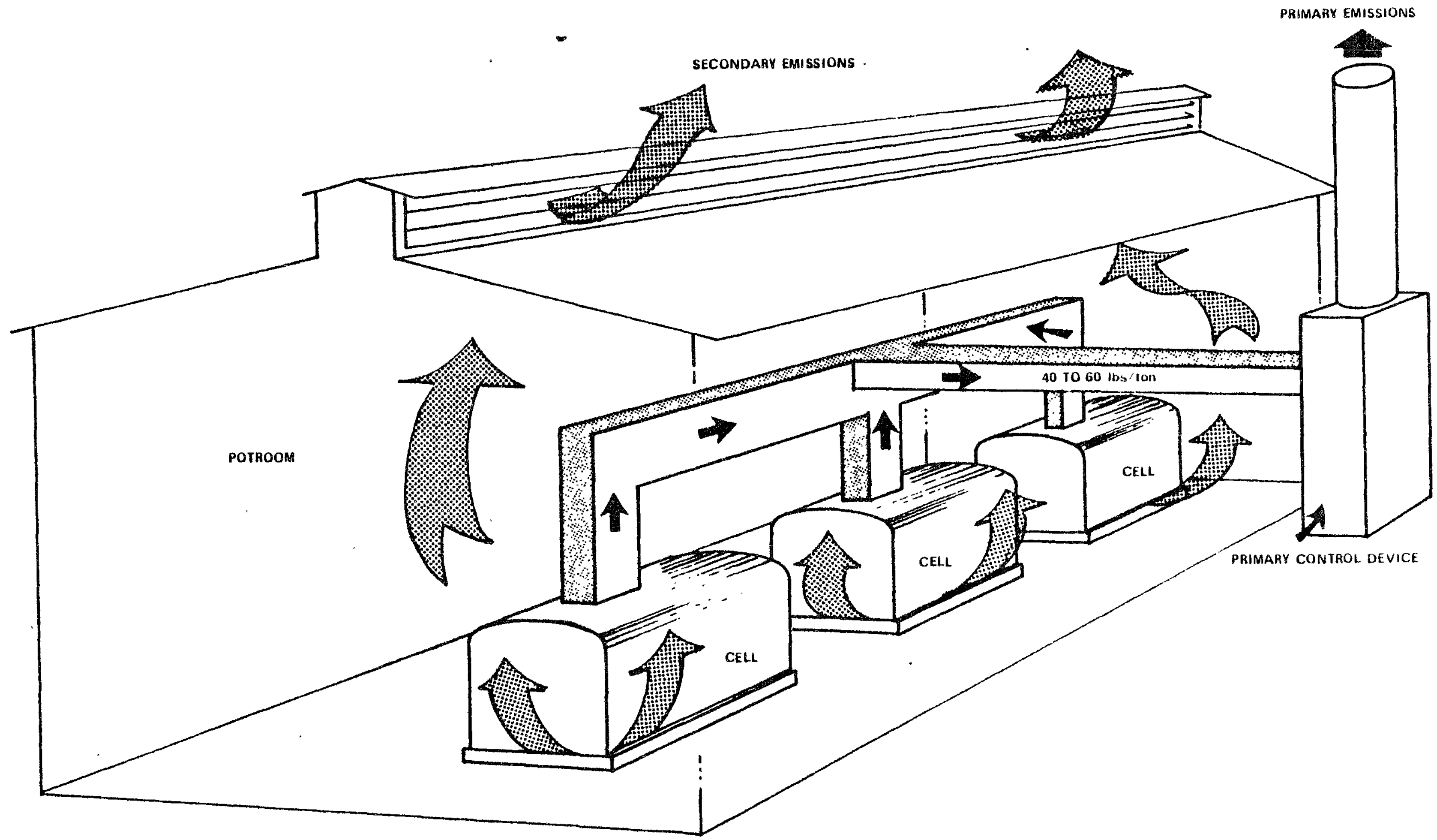

Figure 5-2. Potroom fluoride emission balance.

the potroom. Emissions from this device are termed primary emissions. That portion of the evolved gas stream that escapes the hooding passes to the monitor in the roof of the potroom, where there may or may not be a secondary control device. Emissions from the building are termed secondary emissions.

For potroom emissions, the overall control efficiency (OCE) may be expressed as:

$$OCE = \eta_{pc}\eta_{pr} + (1 - \eta_{pc})\eta_{sc}\eta_{sr} \tag{5.1}$$

where: η_{pc} = Primary collection efficiency

η_{pr} = Primary removal efficiency

η_{sc} = Secondary collection efficiency

η_{sr} = Secondary removal efficiency

Some plants in the United States employ both primary and secondary removal equipment. However, the majority of plants do not have secondary equipment, relying on efficient primary collection (good hooding) to obtain high overall control efficiencies. For these plants, $\eta_{sr} = 0$ and equation (5.1) reduces to:

$$OCE = \eta_{pc}\eta_{pr} \tag{5.2}$$

A few U. S. plants employ only secondary removal equipment. For these plants, $\eta_{pc} = 0$ and equation (5.1) reduces to:

$$OCE = \eta_{sc}\eta_{sr} \tag{5.3}$$

Although secondary collection efficiency might be assumed to be 100 percent in this scheme, deficiency in the design of the provisions for air intake to the buildings may bring about a reduction in the collection efficiency. Some potline buildings have openings in the sidewalls at working floor level through which ventilation air enters as shown in Figure 5-3. This air is supposed to sweep past the cells and up through the roof monitor collection system, but adverse winds may blow through the buildings in such a way as to carry potline emissions out through wall openings in the buildings, thus short circuiting the collection system and reducing its efficiency. Figure 5-4 shows a building arrangement that helps to avoid this short circuiting of the collection system. Fresh air is drawn into the building below the working floor level and is allowed to pass up through gratings past the cells to the monitor collection system.

For the more general case of primary plus secondary control, if it is assumed that all secondary emissions are from the roof monitor, then:

$$\eta_{sc} = 1.0 \tag{5.4}$$

and equation (5.1) can be written in terms of three variables:

$$OCE = \eta_{pc}\eta_{pr} + (1 - \eta_{pc})\eta_{sr} \tag{5.5}$$

Equation (5.5) is the expression of OCE that will be used in discussing retrofit control techniques (Section 6). However, the aforementioned limitation on secondary collection efficiency because of short circuiting should be kept in mind.

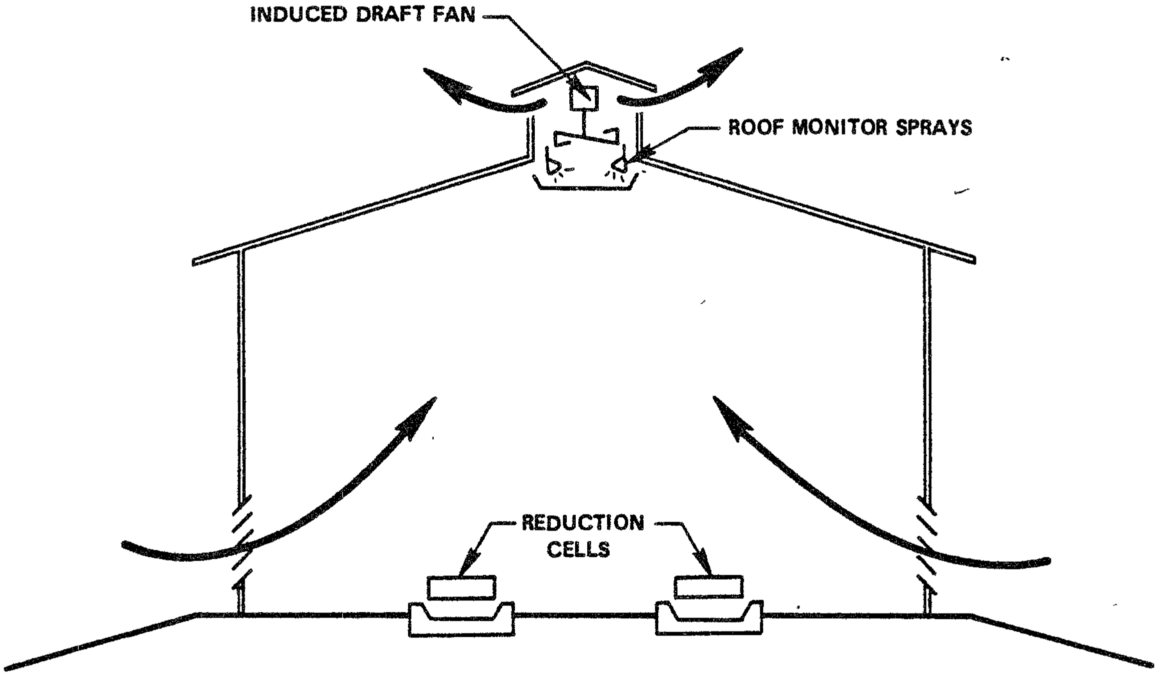

Figure 5-3. Room collection system, sidewall entry.[3]

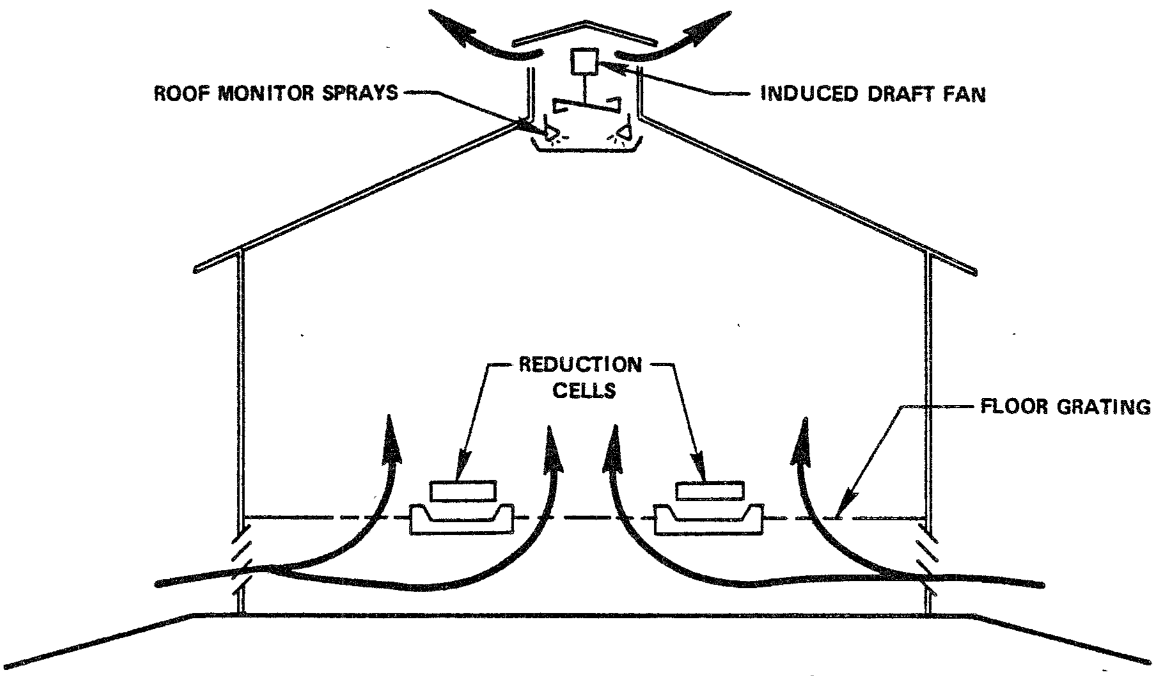

Figure 5-4. Room collection system, basement entry.[3]